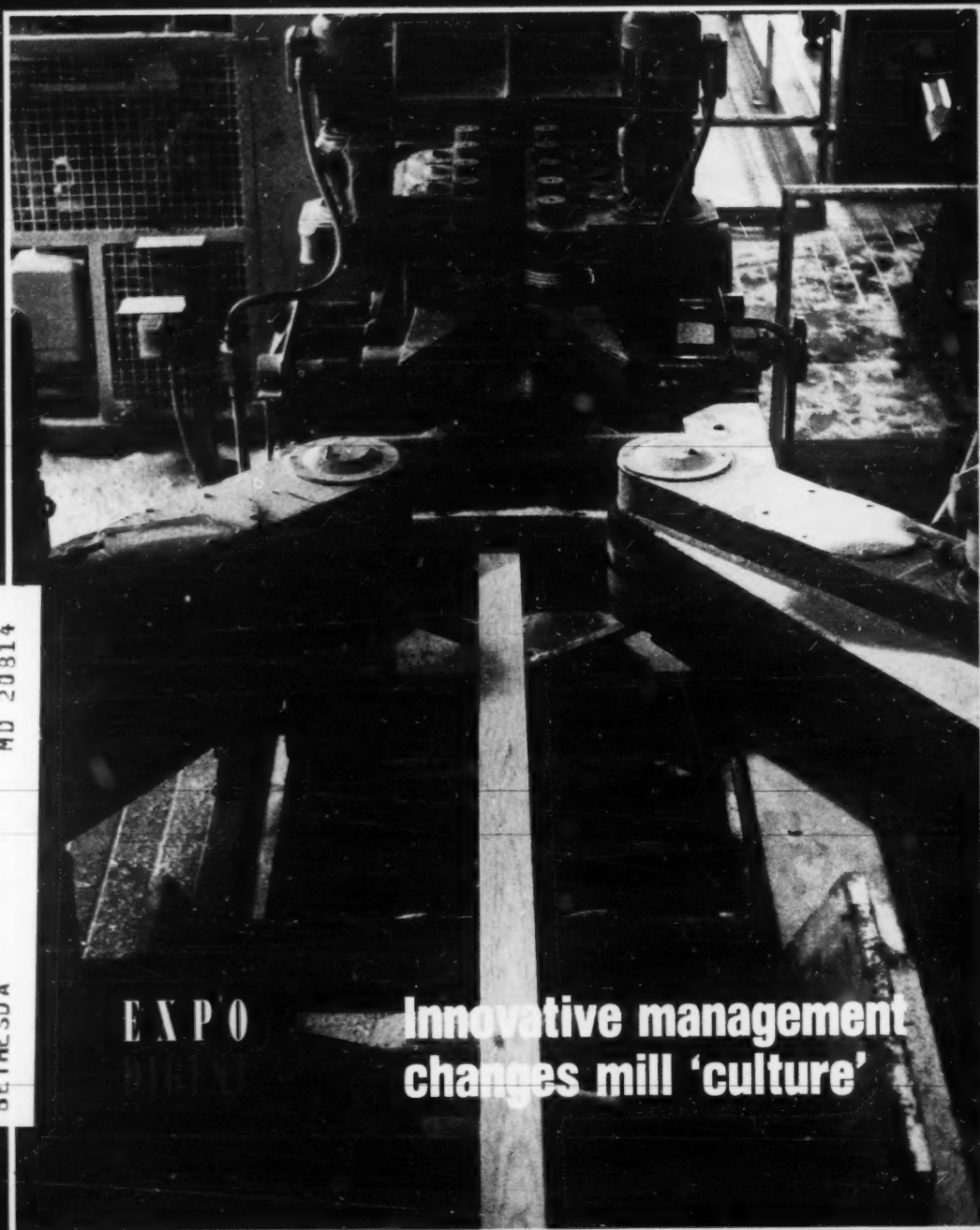


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'Ignorance' of logging costs harms long-term forestry

Current and future profits, forest health depend on knowing the real costs of timber harvesting and transportation

BY DENNIS P. BRADLEY



ur ignorance about the costs of harvesting and transporting logs is profound, despite the fact that they may amount to more than half of all the timber management costs incurred over a rotation.

Because we know so little about harvest and transport costs, few land managers regularly consider how their choices will affect profit or loss far into the future. Unless revenues over a rotation regularly offset all costs, unless regeneration succeeds and unless long-term productivity is protected, timber management may not be an option in many areas. And financial performance may turn out to be the *least important* impact of harvest system development and deployment.

If environmental damage results from poor choices, some forest management may be banned, perhaps unfairly or unnecessarily. Worse, we may be unable to reverse earlier environmental damage.

Four questions must be considered:

- Why do we neglect harvest-transport research?
- How does the Forest Service project harvest and transport technology and costs for the 1989 Resources Planning Act (RPA) Assessment?
- How do technological projections and changing forest conditions interact to determine specific costs used in the 1989 RPA assessment?
- What are the potential impacts of harvest research on costs and environmental protection?

One likely conclusion: the East will play a larger role in filling the nation's woodbasket.

Why do we neglect research?

If harvesting and transport have such profound impacts on ecological, economic and social results, why do we neglect them? Understanding the structure of the forest industry sheds some light on this question.

At the foundation are millions of forest landowners, public and private. Most are unorganized; with the exception of a few large owners, most are "price takers." They rarely cut their own timber. Most are unaware of ways to

reduce costs or use timber better. As a result, returns to these owners have been considered a "residual"—the money left after logging and trucking costs have been subtracted from the mill's FOB log price.

For most landowners, the proposition is "take it or leave it." By contrast, farmers are extremely well-informed about technology's effect on their success. Imagine a farmer's reaction to seeing his corn picker leave every other ear to rot in the field.

Next on the ladder are thousands of logging firms. Most are small, independent contractors with little or no ties to other loggers, landowners or mills. So they are also "price takers," with few long-term incentives to be efficient. They pass their costs on to timber owners willing to sell at the time, reducing the owners' "residual."

Loggers' resourcefulness is legendary: much new technology still originates among these small operators. But since most harvesting innovations are easily copied, exclusive advantages are short-lived. So where do the benefits of new technology go?

Generally, they end up in the much smaller number of mills sitting at the top of the industry ladder. Although mill competitiveness varies widely by region and product, mills have some control over wood prices. They are "price setters," at least for the logger and landowner.

Thus, benefits from increased harvest and transport productivity generally accrue to mills, not to loggers or landowners. Indeed, competition among loggers and landowners tends to force down both log prices and stumpage. It takes market power and financial strength to reap the benefits of harvest research. Only mills and a few large landowners have this clout.

Ironically, most logging and much harvesting research were once done by the forest industry's own employees on company lands. Today, this is rare. What happened? A major cause is surely the widespread land sell-off over the last few decades. Companies sold land partly because of what some call an obsessive interest in short-term profit; others sold to thwart a hostile takeover based on undervalued timberland assets.

Few forest industry firms still own significant timber-

land, so they no longer bear the opportunity costs of inefficient or damaging harvests. But every landowner does bear these costs—especially the U.S. Forest Service and other land management agencies. With Forest Service annual timber sales of about \$1.5 billion, costs only 10% too high (or utilization 10% too low) would cost the taxpayers \$150 million a year. This is a modest estimate, and does not include other losses or environmental damage that are surely occurring.

The fact is, today's harvest systems are socially and economically inefficient. Costs are too high. Too much wood is wasted. Future forest productivity is frequently jeopardized. We are not moving fast enough, or across a broad-enough front, on these harvesting and transport problems.

Indeed, harvest research, carried out fitfully by a small number of companies, universities and federal laboratories, is having an increasingly difficult time getting funding. A Louisiana-Pacific Corp. ad several years ago aptly suggested that if we harvested food as inefficiently as wood, apples would cost \$5 apiece.

The short and long-term implications of this are serious. First, because all forests are mixtures of sites with low to high productivity and species with various properties and uses, inefficiency forces us to commit a larger total area to forest management than we would need with better methods.

Second, mills which must forage farther afield to meet their needs pay higher transport costs for wood. Third, landowners lose when their lands are unnecessarily considered unproductive or inaccessible. Fourth, lands damaged by improper techniques may not yield future revenues or benefits.

Fifth, these inefficiencies combine to increase conflicts with other forest users. For example, it might be possible to avoid cutting irreplaceable old-growth stands. And finally, all of these factors may lead public and private landowners to be less willing to invest today in forest management.

But harvest and transport systems can be more efficient. We can learn to improve productivity and protect other values—just as Scandinavians do.

Unless we do both—improve technology and coordinate management and harvest plans better—public and private landowners will be disappointed by the market outcome. This will put future productivity and other forest values at risk and reduce future timber supplies. Indeed, the "below-cost" timber sale issue, based on real or per-

TABLE 1—Proportions of harvest systems used in 1985 by region, with projections to 2040

Section and region	Projections (%)					
	1985	2000	2010	2020	2030	2040
East—flat terrain						
South—Cable skidding	35.0	30.0	25.0	20.0	15.0	10.0
Grapple skidding	43.0	47.0	51.0	55.0	59.0	63.0
Bobtail trucks and farm tractors	17.0	16.0	15.0	14.0	13.0	12.0
Whole-tree chipping	5.0	7.0	9.0	11.0	13.0	15.0
Total	100.0	100.0	100.0	100.0	100.0	100.0
North—cable skidding	61.0	50.0	40.0	31.0	22.0	14.0
Grapple skidding	26.0	29.0	33.0	36.0	39.0	41.0
Forwarders	5.0	9.0	13.0	17.0	20.0	24.0
Whole-tree chipping	9.0	11.0	14.0	16.0	19.0	21.0
Total	100.0	100.0	100.0	100.0	100.0	100.0
East—mountainous terrain (systems used in both North and South)						
Cable yarding	10.0	16.0	22.0	28.0	34.0	40.0
Skidding and forwarding	90.0	84.0	78.0	72.0	66.0	60.0
Total	100.0	100.0	100.0	100.0	100.0	100.0
West—Douglas fir subregion						
Highlead	20.0	18.0	16.0	14.0	12.0	10.0
Skyline—short	37.5	38.0	38.5	39.0	39.5	40.0
—medium	7.5	8.0	8.5	9.0	9.5	10.0
—long	2.5	2.6	2.7	2.8	2.9	3.0
Tractors	32.5	33.4	34.3	35.2	36.1	37.0
Total	100.0	100.0	100.0	100.0	100.0	100.0
West—Ponderosa pine subregion						
Highlead	3.0	3.4	3.8	4.2	4.6	5.0
Skyline—short	12.0	12.6	13.2	13.8	14.4	15.0
—medium	6.0	6.4	6.8	7.2	7.6	8.0
—long	0.0	0.4	0.8	1.2	1.6	2.0
Tractors	79.0	77.2	75.4	73.6	71.8	70.0
Total	100.0	100.0	100.0	100.0	100.0	100.0
West—Pacific Southwest subregion						
Highlead	6.4	6.1	5.8	5.6	5.3	5.0
Skyline—short	23.2	24.0	24.8	25.4	26.2	27.0
—medium	7.4	8.3	9.2	10.2	11.1	12.0
—long	0.0	0.2	0.4	0.6	0.8	1.0
Tractors	63.0	61.4	59.8	58.2	56.6	55.0
Total	100.0	100.0	100.0	100.0	100.0	100.0
Rocky Mountain subregion						
Tractors and jammers	86.1	83.9	81.7	79.5	77.2	75.0
Cable yarding	13.9	16.1	18.3	20.5	22.8	25.0
Total	100.0	100.0	100.0	100.0	100.0	100.0

ceived failures to manage existing stands economically, is due in part to this neglect and has already reduced tomorrow's timber investments.

Projecting technology and costs

Over the next 50 years, we expect increasing use of more efficient and more productive harvest and transport systems. And each of the surviving systems will become more efficient. Both effects are estimated in the following cost-projection effort.

To start, the Forest Service's five harvesting research projects identified each region's major harvest systems and costs. Actual logging systems vary more than indicat-

ed, but these system mixes capture the essence of regional conditions. Average tree diameter and volume per acre indicate relative costs.

Generally, the cost rank, from lowest to highest, is South, North, Rocky Mountain, East Mountainous, Ponderosa pine subregion, then a tie for costliest between Douglas fir and Pacific Southwest subregions.

Substantial shifts in system mix are expected in each region over the next 50 years (Table 1). On flat land in the East, loggers will rely increasingly on mechanized felling, bunching and grapple skidding to central landings for processing and loading. Feller-bunchers with shears are replacing chain saw felling in pulpwood operations, but saws will be used on some sawlog and veneer operations to prevent valuable butt logs from splitting. More feller-bunchers will be teamed with split-reducing cutting heads.

Grapple skidders will replace most cable skidders by 2040 because they are faster and safer. Their share will rise from 43% to 63% in the South, and 5% to 24% in the North. The South's labor-intensive bobtail truck and farm tractor systems will decline slightly by 2040, from 17% to 12% of roundwood output.

In the North, forwarders are predicted to expand from 25% to 40% of output by 2040. Whole-tree chipping is expected to increase modestly, from 5% to 15% in the South and 9% to 21% in the North.

The East has many "mountainous" forests. While not as rugged as western terrain, eastern mountains are near a large and concerned population, have highly erodible soils and generally less-productive sites. These factors heighten the need for cost-effective, environmentally sound harvesting equipment and methods.

Several small cable yarding systems, adapted from European and West Coast machines, have been used successfully in the East. By 2040, these systems will increase their share of roundwood output from 10% to 40%.

The Pacific Coast's rugged terrain and extremely large

trees often require expensive cable yarding systems. Skyline systems are forecast to gradually replace high-lead rigs. Skyline running gear is more complex and versatile, though both systems use mobile steel towers. Large trees and steep slopes make hand-felling a must.

Ground skidding will continue at current levels in all Pacific regions: from only 33% in the Douglas fir region to 75% in the Ponderosa pine area.

In the Rockies, ground skidding accounts for almost half of logging; jammer systems are used for about 37% of the harvest. Smaller cable yarders adapted from West Coast machines will supplant these systems, moving up from about 14% of the harvest now to 25% by 2040. Loggers will shift to more productive systems which require less labor.

Boosting logging productivity

The second change considered is increased productivity of logging systems. Regardless of technical change, most experts believe that future logging systems will look much like current ones. Tomorrow's logging machines will still have to move over rough surfaces, sever and handle heavy trees or logs and carry them considerable distances in all kinds of weather.

The task for machine and system designers will be to improve in six areas: load capacity, travel and processing speed, reliability and durability, species and product versatility, terrain capability and operator comfort and safety. But optimum machine design is rarely a useful guideline. Maximizing productivity may be appropriate in a controlled factory environment, but versatility is often more important in the woods.

But researchers agree that significant opportunities for improvements exist. The size of these improvements and the speed with which they are adopted will depend in large part on research investment. Specific changes now in progress or being contemplated for feller-bunchers, skidders, forwarders, processing, loading and trucking will be stimulated by these problems:

- Steep and wet terrain.
- Stands with significant amounts of multiple products or currently unmerchantable stands.
- Low-density stands, or those with many small trees.
- Small harvest tracts as required by law or due to fragmented ownerships.
- Increasingly expensive road construction and hauling costs.
- Need to recover branches, tops, bark and other previously unmerchantable material.
- Need to protect long-term forest productivity.
- Worker health and safety.

Major cost-saving opportunities exist in felling, bunching, ground skidding, cable yarding and log transport. These jobs are the most capital and energy-intensive, and are the most dangerous. Fuel-efficient, light-

TABLE 2—Trends in harvested tree diameter and volume per acre by region, 1985 to 2040¹

Section and region	1985	Diameter and volume projections for:				
		2000	2010	2020	2030	2040
South						
Tree diameter (in.)	13.1	13.1	12.9	12.6	12.4	12.2
Volume/acre (mbf)	7.4	9.0	9.6	9.8	9.8	9.7
North						
Tree diameter (in.)	11.3	11.2	11.3	11.3	11.4	11.5
Volume/acre (mbf)	7.5	9.2	10.0	10.5	10.7	10.9
West—Douglas fir subregion						
Tree diameter (in.)	24.9	20.0	18.2	16.3	14.5	12.7
Volume/acre (mbf)	26.5	26.0	26.0	26.1	26.3	26.5
Ponderosa Pine subregion						
Tree diameter (in.)	16.1	14.6	13.9	13.2	12.5	11.8
Volume/acre (mbf)	12.5	12.2	12.2	12.3	12.4	12.5
Pacific Southwest subregion						
Tree diameter (in.)	24.9	20.0	18.2	16.3	14.5	12.7
Volume/acre (mbf)	18.3	15.9	15.9	16.0	16.2	16.3
Rocky Mountain						
Tree diameter (in.)	16.1	14.6	13.9	13.2	12.5	11.8
Volume/acre (mbf)	11.9	13.1	13.6	14.4	14.8	15.0

¹ Diameter trends consider softwoods only. Volume per acre trends consider both softwoods and hardwoods.

er machines and engines should cut energy costs significantly.

Using them will allow longer economical skidding or yarding distances, so fewer roads will be necessary—further reducing both costs and environmental impacts. Depending on machine, function and region, the next 50 years will bring modest improvements in productivity. Estimates for individual machines ranged from 11% to 42%. Overall system improvements will be much lower.

Improving safety and ergonomic design is very important and could have very large impacts. Our current inattention to worker health and safety continues to raise costs. A continuing poor safety record, despite substantial safety efforts, mean a logging worker's compensation costs frequently equal direct payroll expenses.

There is no good reason why improved machine design and safety practices, following proven European experience, would not cut costs and suffering dramatically.

Smaller trees, lower volumes

Average tree diameter and volume per acre must also be considered when projecting future logging costs (Table 2). To compute average harvesting costs for each region, these factors were combined with individual systems' cost, the projected share of wood harvested by each system (Table 1) and expected rates of productivity improvement over the next 50 years. Assumptions about diameter and volume per acre are based on regional inventory and removal models. These probably have the largest effect on harvest cost projections.

Except in the Pacific Northwest, the forecast is for logging costs to increase at a slower rate during the next 50 years than from 1952 to 1985. But everywhere, costs will rise substantially.

Pacific Coast logging costs rise the most because of projected 40% declines in stand diameter between 1985 and 2040. The cost increases are expected to range between 43% (Douglas fir region) and 64% (Ponderosa pine region).

By contrast, a projected 25% decline in average stand diameter in the Rocky Mountains would be offset by increasing volume per acre. Logging costs will rise there 26%. In the South, stand diameter is projected to decline only slightly while stand volume rises 20%, for a minimal 1% cost increase. Logging costs in the Northeast probably will not change much, while North Central region loggers could see their costs fall about 6%.

Savings generated on road system design and construction affect both timber management and all other uses over the life of the road. Where new methods can recover more timber with fewer, smaller, shorter-lived roads, negative soil and water impacts are reduced.

An example is development of Central Tire Inflation Systems (CTIS) for logging trucks. CTIS allows truckers to raise or lower all tire pressures quickly, easily and simultaneously. Low tire pressures cause less damage to forest roads; highway travel requires higher pressures.

Harvest and transport research goes beyond reducing direct costs to focus on protecting environmental values during logging. These efforts may actually raise direct costs to protect long-term forest productivity.

Harvest research could also reduce risk and uncertainty when considering future investments: will owners and

managers be allowed to cut the timber from stands now being planted? This benefit is difficult, perhaps impossible, to measure. So is another indirect benefit of more efficient and versatile logging systems: reduction in wood-yard inventories and their associated carrying costs.

Harvesting technology has gradually improved; there is every reason to expect continued improvement. These social and economic forces may speed progress: making timber management pay its own way, growing concern for adequate wood supplies and concern about logging's long-term effects on forest productivity.

Despite these real needs and opportunities, harvest research budgets have declined in real terms over the past 20 years. Several things might change this.

First, land managers must recognize that today's decisions can reduce future logging costs. They must focus on more productive, accessible sites, emphasize silvicultural treatments that produce larger diameters instead of mere biomass and, where necessary, provide financial incentives to use less-used species and components.

Previous RPA assessments focused on more-intensive forest management as the best way to enhance future timber supplies, with little mention of harvesting and utilization opportunities. Current efforts to provide more objective comparisons could make a great difference to future programs.

Second, small loggers should try to operate closer to capacity, focus on employee training for production and safety, engage competent financial and management expertise and, especially, mount much more aggressive development and lobbying efforts.

Third, major timberland owners, agencies and forest industries must recognize their immense stake in developing productive and socially efficient harvest systems. Successful forestry investment depends on expanding support for formal, well-funded harvesting research in all major species and terrain types. It is likely that no such important ecological and industrial activity in the U.S. economy spends so little on research and development.

Finally, if predicted regional changes in stand diameter and volume per acre occur, cost alone will cause major regional shifts in timber management and timber sales. These will occur regardless of what happens to harvest and transport technology.

Even under the most optimistic forecasts of technical change, projected declines in tree diameters will cause large relative cost increases in the West. Couple these cost increases with other likely environmental restrictions on western forests and the implications are more dramatic.

These problems in the West, combined with recent evidence of significant timber surpluses in the East and emphasis on hardwood management and utilization, suggest an eastward shift in the comparative advantage of timber production in the United States. ■

THE AUTHOR is an economist at the U.S. Forest Service North Central Forest Experiment Station in St. Paul, Minn. The following Forest Service scientists have contributed data and other assistance: William Lange, Madison, Wis.; Charles Mann, Robert McGaughey and Michael Gonsior, Seattle, Wash.; Penn Peters, Morgantown, W.Va.; Donald Sirois and Bryce Stokes, Auburn, Ala.; and Michael Thompson, Houghton, Mich.

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